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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/814,424	03/21/2001	Francisco A. Leon	42390.P11005	4073

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EXAMINER	
SONG, MATTHEW J	

ART UNIT	PAPER NUMBER
1765	

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Please find below and/or attached an Office communication concerning this application or proceeding.

AS

Office Action Summary	Application No.	Applicant(s)	
	09/814,424	LEON ET AL.	
	Examiner	Art Unit	
	Matthew J Song	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *21 November 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,3,4 and 6-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,3,4 and 6-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/21/2003 has been entered.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1, 3 and 16-18 are rejected under 35 U.S.C. 102(b) as being anticipated by Huang et al (US 5,956,598).

Huang et al discloses a semiconductor substrate **300** is prepared, a pad oxide layer **302**, this reads on applicant's cladding material, over the substrate, a mask layer **304** of silicon nitride over the pad oxide layer, this reads on applicant's material, a photoresist layer is coated thereon and is then selectively removed and an anisotropic dry etching process, this reads on applicant's

vertical etch, is performed to etch away the unmasked portions of the mask layer **304**, the pad oxide layer **302** and the substrate **300**. Huang et al also discloses a trench **306** is formed through this process, this reads on applicant's selectively removing portions of a material to obtain a region that defines a corner. Huang et al also discloses a pre-liner cleaning process is performed on the exposed surfaces of the substrate in the trench with RCA-A and a 10:1 solution of deionized water and hydrofluoric acid and during this process a small edge part of the pad oxide layer is etched away, resulting in the forming of a sharp corner **307**, this reads on applicant's isotropically etching additional portions of the materials from the region of the material to sharpen the corner. Huang et al also discloses an insulating material, such as silicon dioxide, is deposited through a CVD process into the trench (col 3, ln 55 to col 4, ln 67).

Referring to claim 1, Huang et al teaches a pre-liner cleaning process is performed on the exposed surfaces of the substrate in the trench with RCA-A and a 10:1 solution of deionized water and hydrofluoric acid and during this process a small edge part of the pad oxide layer is etched away, resulting in the forming of a sharp corner **307** (col 4, ln 1-15). Huang et al does not teach this is an isotropic etch. Hydrofluoric acid is well known in the art to be an isotropic etch, as evidenced by Hseih et al (US 5,880,019), Chou (US 5,985,725), Hsu et al (US 5,918,131) and Hsueh et al (US 5,91,356) below, and the application of HF acid results in a sharp corner, as applicant. Therefore, the pre-liner cleaning process taught by Huang et al is inherently an isotropic etch.

Referring to claim 3, Huang et al discloses a photoresist layer (col 3, ln 60-67).

Referring to claim 17, Huang et al is silent to etching the cladding material to define a rounded corner. However, this is inherent to Huang et al because Huang et al teaches a similar

anisotropic etching through a photoresist, as applicant, therefore a rounder corner is inherently formed.

Referring to claim 18, Huang et al discloses depositing an insulating material, this reads on applicant's core material, in the trench.

4. Claims 1, 3-4, 6-7, 17-18 and 21 are rejected under 35 U.S.C. 102(e) as being anticipated by Pan (US 6,322,634).

In a method of forming a shallow trench, Pan discloses a silicon substrate **102**, a dielectric layer **104** of silicon dioxide and a buffer layer **106** of silicon nitride, this reads on applicant's material, where the silicon dioxide and silicon nitride layers are formed by chemical vapor deposition (col 3, ln 40-57). Pan also discloses a photoresist mask **108** is applied over the buffer layer and patterned using photolithographic patterning techniques and the buffer layer and the dielectric layer are then etched by standard etching techniques to form a patterned recess **110**. Pan also discloses the silicon substrate is then dry etched, this reads on applicant's vertical etch, to form a shallow trench and anisotropic etch, this reads on applicant's corner, and the photoresist mask is stripped to form a trenched structure (col 3, ln 58 to col 4, ln 5). Pan also discloses after stripping the photoresist and cleaning with H_2O_2/H_2SO_4 or H_2O_2/HCl a thin layer of oxide is grown in the shallow trench. Pan also teaches the buffer layer is wet etched using HF and the trench is then filled with an isolation material **122** of silicon dioxide formed by chemical vapor deposition (col 4, ln 6-30). Pan also discloses the isolation material is removed down to the buffer film layer by chemical mechanical planarization (col 4, ln 31-67).

Pan et al is silent to further isotropically etching additional portions of the material from the region to sharpen the corner. However, Pan does teach an etching step after the trench formation and a wet etching using HF, therefore portions of the material from the region of the material are inherently removed, sharpening the corner because Huang et al (US 5,956,598) and Lin et al (US 6,194,285) teach a corner being sharpened by using a wet etchant, as discussed previously. Also, Pan et al teaches using a wet etch of HF, which is inherently isotropic as evidenced by, Hseih et al (US 5,880,019), Chou (US 5,985,725), Hsu et al (US 5,918,131) and Hsueh et al (US 5,91,356), below.

Referring to claim 3 and 21, Pam discloses a photoresist mask **108**.

Referring to claim 4, Pan discloses removing the photoresist prior cleaning and etching with HF.

Referring to claim 6-7, Pan discloses an isolation material and chemical mechanical planarization, this reads on applicant's chemical mechanical polishing method.

Referring to claim 17, Pan discloses a buffer layer of silicon nitride, this reads on applicant's cladding material, and etching the buffer layer with HF. Pan is silent to the etching to define a rounded corner, however this is inherent to Pan because Pan teaches a similar etching method, as applicant, therefore inherently forms a rounded corner.

Referring to claim 18, Pan et al discloses depositing silicon dioxide in the trench, this reads on applicant's core material.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1, 3-4, 6-7, 17-18 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pan (US 6,322,634) as applied to claims 1, 3-4, 6-7, 17-18 and 21 above, and further in view of Huang et al (US 5,956,598).

Pan discloses all of the limitations of claim 1, as discussed previously, except the isotropically etching of additional portions of the material from the region of the material to sharpen the corner, which the Examiner maintains is an inherent feature to Pan. However, if evidence were provided which shows the feature is not inherent, it would still be obvious in view of Huang et al.

Huang et al discloses a semiconductor substrate **300** is prepared, a pad oxide layer **302**, this reads on applicant's cladding material, over the substrate, a mask layer **304** of silicon nitride

over the pad oxide layer, this reads on applicant's material, a photoresist layer is coated thereon and is then selectively removed and an anisotropic dry etching process, this reads on applicant's vertical etch, is performed to etch away the unmasked portions of the mask layer **304**, the pad oxide layer **302** and the substrate **300**. Huang et al also discloses a trench **306** is formed through this process, this reads on applicant's selectively removing portions of a material to obtain a region that defines a corner. Huang et al also discloses a pre-liner cleaning process is performed on the exposed surfaces of the substrate in the trench with RCA-A and a 10:1 solution of deionized water and hydrofluoric acid and during this process a small edge part of the pad oxide layer is etched away, resulting in the forming of a sharp corner **307**, this reads on applicant's isotropically etching additional portions of the materials from the region of the material to sharpen the corner. Huang et al also discloses an insulating material, such as silicon dioxide, is deposited through a CVD process into the trench (col 3, ln 55 to col 4, ln 67).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Pan with Huang et al's pre-liner cleaning processes to remove residue from the dry-etching process, which is detrimental to the device.

Referring to claim 1, the combination of Pan and Huang et al teaches a pre-liner cleaning process is performed on the exposed surfaces of the substrate in the trench with RCA-A and a 10:1 solution of deionized water and hydrofluoric acid and during this process a small edge part of the pad oxide layer is etched away, resulting in the forming of a sharp corner **307** (col 4, ln 1-15). The combination of Pan and Huang et al does not teach this is an isotropic etch. Hydrofluoric acid is well known in the art to be an isotropic etch, as evidenced by Hseih et al (US 5,880,019), Chou (US 5,985,725), Hsu et al (US 5,918,131) and Hsueh et al (US 5,91,356)

below, and the application of HF acid results in a sharp corner, as applicant. Therefore, the pre-liner cleaning process taught by the combination of Pan and Huang et al is inherently an isotropic etch.

7. Claims 8-10 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pan (US 6,322,634) or Pan (US 6,322,634) in view of Huang et al (US 5,956,598), as applied to claims 1, 3-4, 6-7, 17-18 and 21 above, further in view of Binkley et al (US 6,022,671).

Pan or the combination of Pan and Huang et al discloses all of the limitations of claim 8, as discussed previously, except placing a third material over the second material.

In a method of forming a hybrid waveguide by a trench based manufacturing process, Binkley et al teaches shallow trenches are cut into a material and filled with either a core ore a cladding material. Binkley et al also teaches a photolithographic process and associated etch produces an open trench and these trenches are filled with a material and subsequently planarized by using chemical mechanical polishing. Binkley et al also teaches a core material **111** is deposited to fill a set of trench openings and a second cladding layer **118** is applied thereon (col 11, ln 1 to col 12, ln 67 and Fig 6A-J).

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Pan or the combination of Pan and Huang et al with Binkley et al's method of filling a trench and depositing cladding layers to form a optical waveguide because an optical waveguide is useful in the communications industry (col 1, ln 1-30).

8. Claims 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pan (US 6,322,634) or Pan (US 6,322,634) in view of Huang et al (US 5,956,598), as applied to claims 1, 3-4, 6-7, 17-18 and 21 above, further in view of Ido et al (WO 98/37445), where US 6,229,949 is used as an accurate translation and a translation of WO 98/37445 can be provided upon request.

Pan or the combination of Pan and Huang et al discloses all of the limitations of claim 11, as discussed previously, except he corner comprises part of Y-branch of an integrated optical device.

In a method of making an optical waveguide by etching a substrate, note entire reference, Ido et al teaches a silicon substrate **1** having a SiO_2 film **40** and etching a portion of a core layer by reactive oxygen ion etching so as to from a waveguide pattern including Y branching structures and then an upper clad layer **4** is coated (' 949 col 7, ln 1-50 and col 1, ln 10-65). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Pan or the combination of Pan and Huang et al with Ido et al's pattern to form a optical waveguide useful in an optical communication apparatus ('949 col 7, ln 39-50)

9. Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Pan (US 6,322,634) or Pan (US 6,322,634) in view of Huang et al (US 5,956,598), as applied to claims 1, 3-4, 6-7, 17-18 and 21 above, further in view of Nakos et al (US 6,054,745).

Pan or the combination of Pan and Huang et al discloses all of the limitations of claim 13, as discussed previously, except the corner comprises part of one of a microelectromechanical structure device (MEMS), a photonic crystal device, or a photonic bandgap device.

In a method of forming a microelectromechanical switch, note entire reference, Nakos et al teaches a fabrication process for the microelectromechanical switch, this reads on applicant's MEMS, using a shallow trench isolation (STI) structure **24** (col 4, ln 45-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Pan's or the combination of Pan and Huang et al's shallow trench isolation structure with Nakos et al's method of forming a microelectromechanical switch using shallow trench isolation structure to form a switch useful in a nonvolatile memory cell structure (col 4, ln 45-60).

10. Claims 14-15 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pan (US 6,322,634) or Pan (US 6,322,634) in view of Huang et al (US 5,956,598), as applied to claims 1, 3-4, 6-7, 17-18 and 21 above, further in view of Kleinknecht (US 4,039,370).

Pan or the combination of Pan and Huang et al discloses all of the limitations of claim 14, as discussed previously, except forming a diffraction grating pattern having pillars of a substantially same radius as the corner to be sharpened as the corner to be sharpened; illuminating the pillars with a light and detecting light diffracted from the pillars; removing the pillars concurrently with removing portions of the material adjacent to the region and determining if sufficient time ha elapsed to sharpen the corner based on the detected light diffracted from the pillars as they are removed.

In a method of optically monitoring a layer being etched, note entire reference, Kleinknecht teaches a layer **10** of silicon dioxide disposed on a substrate **12** and the layer **10** is selectively etched through an opening in a pattern **16** of a masking material, such as a photoresist, disposed thereon (col 1, ln 65 to col 2, ln 30). Kleinknecht also teaches optically

monitoring the amount of undercutting of the layer **10**, while being etched in the etchant using a diffraction grating pattern **26** including spaced strips of masking material with different widths, this is interpreted to by the examiner to read on applicant's pillars of same radius of the corner (col 2, ln 31 to col 3, ln 15. Kleinknecht also teaches exposing a diffraction grating pattern to a beam **38** of light and monitoring a diffracted beam by utilizing photodetectors (col 3, ln 15 to col 4, ln 13). Kleinknecht also teaches a diffraction grating pattern immersed in an etchant **48** and monitoring diffracted beams of light (col 5, ln 15-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Pan or the combination of Pan and Huang et al with Kleinknecht's diffraction grating to monitor an etching process to provide in-process control and a desired amount of undercutting (col 6, ln 35-55).

Response to Arguments

11. The arguments against the Lin et al (US 6,194,285) reference are persuasive and the rejection has been withdrawn.

12. Applicant's arguments with respect to claims 1, 3-4 and 6-21 have been considered but are moot in view of the new ground(s) of rejection.

13. Applicant's arguments filed 11/21/2003 have been fully considered but they are not persuasive.

Applicant's arguments against the Huang reference are noted but are not found persuasive. Applicant alleges that Huang does not teach an isotropic etch to remove portions of

the pad oxide layer (pg 7). The Examiner admitted in the rejection that Huang does not explicitly teach isotropically etching the pad oxide layer. However, Huang et al teaches using a HF etchant, which is well known in the art to be an isotropic etchant, as evidenced by Hseih et al (US 5,880,019), Chou (US 5,985,725), Hsu et al (US 5,918,131), Hsueh et al (US 5,91,356) below, and Huang et al teaches forming a sharp corner, as applicant. Therefore, the HF etchant is inherently isotropic because Huang uses an isotropic etchant and results in a sharp corner, as applicant.

Applicant's arguments against the Huang reference for teaching away from the claimed invention are noted but are not found persuasive. Teaching away is a secondary consideration, which is not applicable to a 102-anticipation rejection. Furthermore, Huang et al teaches a similar method, as claimed by applicant, which results in an intermediate product with a sharp corner, which is further processed to round the corner. The method of forming the intermediate product reads on applicant's claimed invention.

Applicant's argument against the Pan reference is noted but is not found persuasive. Applicants allege that Pan does not teach isotropically etching additional portions of the material from the region to sharpen the corner. The Examiner has admitted this deficiency in the rejection and maintains this feature is inherent to Pan. Pan teaches a wet etch using hydrofluoric acid, which is inherently isotropic etchant, as evidenced by Hseih et al (US 5,880,019), Chou (US 5,985,725), Hsu et al (US 5,918,131), Hsueh et al (US 5,91,356) below. Also, Pan teaches the removal of a buffer film layer **106** (col 4, ln 1-20).

Applicant's arguments that Huang et al does not teach a rounded corner (pg 9) is noted but is not found persuasive. Applicant alleges that Huang et al does not teach the cleaning

process is anisotropic, which is not the basis of rejection by the Examiner. The Examiner based the rejection of dependent claim 17, on the anisotropic dry etch of the pad oxide layer inherently results in a rounded corner, which is made sharp by performing the pre-liner cleaning process using a well known isotropic etchant, HF. Claim 17 requires the rounded corner to become after isotropically etching, which is inherent to Huang et al.

Applicant's argument that the Pan reference does not teach isotropically etching is noted but is noted found persuasive. The Examiner has provided rationale and evidence tending to show inherency by providing the Huang et al reference, which teaches an isotropic etch results in a sharp corner and a similar process, as claimed by applicant, would inherently result in the formation of a sharp corner. Also, Pan teaches an additional etch using HF (col 4, ln 5-20), which a well-known isotropic etchant.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Wang et al (US 2002/0136518) teaches forming a waveguide by etching and filling with a core material (Abstract).

Van der Tol ("Sharp Vertices in Asymmetric Y-Junctions by Double Masking") teaches a double heterostructure on an InP substrate and a reactive ion etch is used to obtain sharp vertices in asymmetric Y junctions, this reads on applicant's corner (pg 249, col 2 and Fig 1).

Chen (US 6,194,284) teaches a first anisotropic etch into the substrate layer **12** and a second isotropic etching to produce an isotropically etched trench with a greatly diminished

number of surface asperities on a smooth trench surface, this reads on applicant's further removing portions of the material adjacent to the region (col 4, ln 10 to col 5, ln 20).

Hsueh et al (US 5,91,356) teaches oxide is isotropically removed with a wet etchant such as diluted 100:1 HF (col 3, ln 1-5).

Hsu et al (US 5,918,131) teaches a pad oxide layer is removed using an isotropic etching solution such as hydrofluoric acid (col 1, ln 30-35).

Chou (US 5,985,725) teaches a pad oxide layer is isotropically removed using hydrofluoric acid (col 1, ln 55-65).

Hseih et al (US 5,880,019) teaches isotropically etching an insulating layer using 10:1 HF etch (col 5, ln 20-25).

Lin et al (US 5,874,353) teaches a method of making a shallow trench isolation region using an anisotropic dry etching method (col 1, ln 40-50).

Lin et al (US 6,194,285) discloses during an isotropic wet etches process, a sidewall **55** retreats to **53** while a groove like recess is formed and a corner becomes sharpened further (col 1, ln 40-67), this reads on applicant's further removing portions of the materials from the region of the material to sharpen the corner because the sidewall is made of the layers **20** and **30** (Figs 1a-1f).

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Matthew J Song
Examiner
Art Unit 1765

MJS

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER